# METAL PROGRESS

THE MAGAZINE OF MATERIALS AND PROCESS ENGINEERING

### Volume 83 January 1963 through June 1963

ALLEN G. GRAY, Editor; Editor, Periodical Publications, ASM

RALPH G. DERMOTT, Managing Editor

CARL R. WEYMUELLER
Associate Editor

ELIZABETH M. ALDRICH Assistant Editor FRED L. SIEGRIST
Associate Editor

FLOYD E. CRAIG Art Director



Metal Progress Is Owned and Published by

THE AMERICAN SOCIETY FOR METALS

Metals Park, Ohio

#### Subject Index

The subject headings used in this index are chosen in accordance with the ASM-SLA Metallurgical Literature Classification, International (Revised) Edition, published by the American Society for Metals, 1958.

Adhesive joining Adhesives for Fabricating High Strength Structures, by Eugene F. Hess	Principal Steels Used in Heat Treated Parts for German Automobiles, by Heinz W. Balster (ds)	Cast iron High Integrity Castings for Ordnance Applications, by John Schuyten 3-7 Materials and Processes Used in Fiat Cars, by Carlo F. Bona 1-6  Cast iron, gray Nondestructive "Tensile Testing" of Cast Iron, by Werner A. Felix 2-9
Adhesives  Epoxy Tape Adhesive Bonds Airliner Fuselage (tn)	Reinforced Plastics, by Fred L. Siegrist 4-97 The Volkawagen Story 1-80 Bearings	Cast iron, nodular Nodular Iron Production Sets Record in
Aging Step Aging of 17-7 PH Stainless Steel, by William A. Token and John J. Heldt	How Bearings Fail, by W. E. Littmann and C. A. Moyer (d)	1962 (tn) 3-1  Ceramics  Determining Elastic Moduli of Materials by Resonance, by T. W. Gibbs and C. L. Theberge 2-9
Aircraft Problems in Selecting Alloys for the Supersonic Transport, by Paul H. Denke 3-71 Trends in Structural Applications for Reinforced Plastics, by Fred L. Siegrist 4-97	Plastic-Steel Bearing Solves Lubrication Problem (tn) 1-11 Reproducing Contact Failures in Bearings, by R. E. Denning and S. L. Rice (d) 4-174  Beryllium alloys	How to Deposit Metallic and Nonmetal- lic Coatings With the Plasma Arc Torch, by LeRoy W. Davis 3-10 Materials for Blast Deflectors, by S. R. Locke, H. H. Chandler, P. G. Sayers and E. J. Wheelehan (d) 4-17 Materials Progress (tn) 5-1
Aluminum  Corrosion of Aluminum, by K. F. Lorking (d)	Compatibility of Metals and Cryogenic Liquids, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell4-100 Biographies	Cermets  How to Deposit Metallic and Nonmetallic Coatings With the Plasma Arc Torch, by LeRoy W. Davis
Materials and Processes Used in Fint Cars, by Carlo F. Bona	ASM's President for 1962-63, by Roland A. Kozlik 6-88 William Park Woodside and the ASM 5-66	Chromate coatings Surface Protection With Chromate Coatings, by Walter E. Pocock 6-8
Thick Aluminum Plates Welded in Two Passes (tn) 4-7 Vacuum Deposited Aluminum Protects	Blast furnace Predicting Effects Inside a Blast Furnace, by A. L. Hodge (d)2-151	Chromium, electroplating of Plating Stainless Steels With Chromium, by Edgar Seyb, Jr. (d)6-16:
Aluminum alloys Compatibility of Metals and Cryogenic Liquids, by Jack L. Christian, James E. Chafey, Abraham Hurlith, James F. Watson and William E. Witzell. 4-100 Lead and Bismuth Improve Machinability of Aluminum Alloys (Phomer Dotts) Materials and Fabrication Methods Used in the Gemini Spacecraft, by Homer Dotts Naturally Aging Aluminum Alloy Remains Strong When Welded (In) 2-11 Progress in Sintered Aluminum Alloys, by John G. Solomir. 1-105 Structural Alloys for Cryogenic Service, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell 3-101 A Study of Brittle Fracture in Cryogenic Alloys, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell 5-103 A Test for Corrosion in Aluminum Alloys, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell 5-103 A Test for Corrosion in Aluminum Alloys, by M. K. Budd and F. F. Booth (d) Loss, by M. K. Budd and F. F. Booth (d) Robert (d) 6-76  Annealing Annealing Blackplate Continuously, by S. Garber (d) 6-168 Annealing Stainless Strip, by C. A. Graham and G. E. Rowan (d) 6-171 Ergang and P. H. Huppertz (d) 6-171	Fabricating and Finishing of Magnesium Die Castings, by Arthur R. Tinetti, Elben F. Schultz Jr. and Leo C. Mangett, Jr. 2-67  Bonding  Epoxy Tape Adhesive Bonds Airliner Fuselage (tn) 2-10 Joining Dissimilar Metals, by Wilson B. Tuffin (c) 6-110 New Ways to Bond Dissimilar Materials, by F. Zimmer 1-101  Brazing Reactive Brazing — a New Joining Method, by Arthur G. Metcalfe 5-83 Welding and Brazing of Tantalum and Columbium, by Melvin J. Albom 4-82 Welding and Brazing of Tungsten and Molybdenum, by Melvin J. Albom 3-84  Brittleness Brittleness in Intermetallics, by J. H. Westbrook and D. L. Wood (d) 6-142  Burst tests Burst Testing of High Pressure Tubing, by R. C. Angell 6-73  Cadmium, finishing Surface Protection With Chromate Coatings, by Walter E. Pocock 6-83  Carburizing Carburizing by the "Drip Feed" Method in Switzerland, by Urs Wyss. 1-86	Cleaning  Descaling by Vacuum Annealing, by E. Ergang and P. H. Huppertz (d)
Atomic energy Cost of Nuclear Power Continues Down Trend (tn)	Case hardening Case Hardening Steels for Gears in Mercedes Cars and Trucks, by Hans Sigwart	Computers Combination Computer: Aid to Industrial Planning (tn) 1-11
Austenite New Thoughts on Crystallization, by James B. Austin	Casting, continuous Continuous Casting Gets Real Test in Steel Plant (tn)	Controlled atmospheres Gas Carburizing by the "Drip Feed" Method in Switzerland, by Urs Wyss 1-86
Automation When and Where to Automate, by Harry B. Osborn, Jr	Casting, pressure Pressure Casting of Steel, by Hale H. Hursen 4-67 Properties of Pressure Poured Steel, by	Conversion charts Conversion Charts for Time-Tempera- ture Parameters, by David C. Gold- berg
Automobiles  Case Hardening Steels for Gears in Mercedes Cars and Trucks, by Hans Sig-	J. J. Downs, C. G. Mickelson and H. W. McQuaid 4-72	Copper Industrial Electrolytic Polishing in France, by Robert Mondon 1-95
Materials and Processes Used in Fiat Cars, by Carlo F. Bona 1-66	High Integrity Castings for Ordnance Applications, by John Schuyten 3-77	Shrinkage of Copper and Iron Powder Compacts During Sintering, by Oleg V. Roman and Henry H. Hausner2-104

Copper, oxygen-free Material Requirements for Vacuum Tubes, by Carl E. Schoder and David	Extraction and refining Metal Production in India, by B. R. Nij- hawan	Gas turbines, materials for Titanium Alloys in Britain, by H. C. Childs 6-
K. Davis	Extrusion  Joining Dissimilar Metals, by Wilson B.  Tuffin (c)	Gears Case Hardening Steels for Gears in Mercedes Cars and Trucks, by Hans Sigwart
Corrosion  Corrosion and the Delhi Pillar, by W. E. Bardgett and J. F. Stanners (d)	Versatile Extrusion Press Does Close Tolerance Work (tn)	A Belated Valentine, by Charles F. Reinke (c) 3-11 Egypt, by D. G. Westlake (c) 3-11 Here's Looking at You', by G. F. Lockeman (c) 2-11 World's Smallest Anchor, by E. F. Heintzelman (c) 4-16
pheres, by H. R. Copson (d) 2-172 Protecting an Oil Refinery From Corrosion (d) 6-154 A Test for Corrosion in Alluminum Alloys, by M. K. Budd and F. F.	and C. A. Moyer (d)	Grain growth Grain Growth and Vanadium, by D. Webster and G. B. Allen (d)6-16 Graphite Materials for the New Technologies 4-
Booth (d) 2-174  Crystal structure New Thoughts on Crystallization, by James B. Austin 5-67	Fatigue Strength of Leaded Steels, by G. W. Brock and G. M. Sinclair (d) 4-144 Ferrite	Graphite, pyrolytic  Flame Polishing Pyrolytic Graphite, by Edward R. Stover (c)  More on Polishing Pyrolytic Graphite,
Die casting Fabricating and Finishing of Magnesium	New Thoughts on Crystallization, by James B. Austin 5-67  Finishing Suwage and Metal Finishing Wester by	by William C. Coons (e)
Die Castings, by Arthur R. Tinetti, Elben F. Schultz, Jr. and Leo C. Man- gett, Jr	Sewage and Metal Finishing Waste, by Leslie E. Lancy (d) 5-157 Surface Protection With Chromate Coatings, by Walter E. Pocock 6-83	Hardening, dispersion Dispersion Strengthened Alloy Available in Sheet Form (tn)
New Thoughts on Crystallization, by James B. Austin 5-67  Drawing	Flame Plating Flame Plating Coats Sheet With Tung- sten Carbide (tw)	Hardness conversions  A Chart for Converting Scleroscope and Rockwell Hardness, by David G. Yorke 2-9 Converting Scleroscope and Rockwell Hardnesses, by David G. Yorke (dg)2-961
Forming and Finishing of Range Components at Tappan, by Fred L. Siegrist 2-86	Flaw detection, eddy current Eddy Current Testing Fast and Versatile, by R. A. Seidel 5-87	Corrected Chart for Hardness Conver- sion, by David G. Yorke (c)4-10 Heat resisting alloys
Drawing, deep Sheet Metal Forming in Europe an International Symposium, by Tom Bishop (d)2-156	Flaw detection, nondestructive  How Valid Are Requirements for Non- destructive Testing of Welds? by Jay  Bland (cp) 4-65	Determining Elastic Moduli of Materials by Resonance, by T. W. Gibbs and C. L. Theberge2-9 How Orbiting Affects Metals, by John
Editorials  The Acceleration of Research Benefits, by Allen G. Gray (cp) 2-65 Fifty Years Young, by Allen G. Gray	Flaw detection, radiographic TV Screen Replaces Film in New X-Ray Inspection Unit (tn) 5-8	How to Heat Treat Space Age Materials, by Cecil C. Lacy and Leopold Albertin 3-81 Machining Heat Treated HS-25 and In-
(cp) 1-65  New Challenge in Materials, by Allen G. Gray (cp) 5-65  Producing for the New Technologies, by Allen G. Gray (cp) 3-65  Progress in Steel, by Allen G. Gray (cp) 6-65	Flaw detection, ultrasonic  Nondestructive "Tensile Testing" of Cast Iron, by Werner A. Felix	conel Alloy 700 (ds) 4-96F Materials for the New Technologies 4-f Pickling and Descaling Stainless Steels and High Temperature Alloys, by John A. Gurklis and L. D. McGraw 6-9f Pickling Stainless Steels and High Tem- perature Alloys, by John A. Gurklis
Elastic properties Determining Elastic Moduli of Materials by Resonance, by T. W. Gibbs and C. L. Theberge	Quenching Nickel Base Sheet in a Fluidized Bed, by Ian Astley and Wilfred Merrett (d)	perature Alloya, by John A. Gurklis and L. D. McGraw (ds)6-96E Problems in Selecting Alloys for the Su- personic Transport, by Paul H. Denke 3-73 Selecting Conveyor Belts for High Temperature Service, by Donald E. Andrews5-91
Electrical equipment MHD and Superconductivity Team Up in Unusual Electric Generator (tn) 2-10	Forging Properties of Pressure Poured Steels, by J. J. Downs, C. G. Mickelson and H. W. McQuaid	Heat resisting steels
Electron beam gun Gas Focusing Improves Electron Beam Gun (tn) 1-10	Forming Fluid Forming Unit Fits Into Conventional Presses (tn)	Notes, by James G. Kerr 5-95 Microstructures of Cast N155 Aged 750 Hr at Elevated Temperatures, by James G. Kerr (ds) 5-96B New Steels Withstand Higher Tempera- tures and Pressures (d) 3-176
Electron beam melting Using Electron Beam Melting Equipment, by Steven D. Hurwitt and Malcolm A. Adams2-101	Sheet Metal Forming in Europe an International Symposium, by Tom Bishop (d)	Heat treatment High Integrity Castings for Ordnance Applications by John Schuyten
Electron microscopy Electron Microscopy Across the World, by Elizabeth P. Hartner (d)	Foundry practice Automatic Conveyor Juggles Big Molds and Castings (sr) High Integrity Castings for Ordnance Applications, by John Schuyten 8-77	How to Heat Treat Space Age Materials, by Cecil C. Lacy and Leopold Albertin 3-89 Principal Steels Used in Heat Treated Parts for German Automobiles, by Heinz W. Balster (ds)
Specimen Acts as Electron Mirror in New Microscope (tn) 1-9  Electronic equipment	Fracture Fracture Study by Electron Microscope, by J. T. McGrath, J. G. Buchanan and R. C. A. Thurston (d)1-170	Heat treatment, induction Improving Properties by Induction Processes, by Harley F. Gauker 2-78 New Heating and Melting Processes, by
Material Requirements for Vacuum Tubes, by Carl E. Schoder and David K. Davis 3-97	Fracture, brittle Put the Brakes on Pipeline Designs, by J. Gordon Parr and A. Hanson	John M. Edwards 2-74 The Use of Susceptors in Induction Heating, by Joseph F. Libsch and Pasquale Capolongo 4-77
Electroplating Chromium Plated Steel for Cans a Japanese Innovation, by Hiromu Uchida and Akira Horisuchi Plating Stainless Steels With Chromium, by Edgar Seyb, Jr. (d)6-163	A Study of Brittle Fracture in Cryo- genic Alloys, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Wit- zell	When and Where to Automate, by Harry B. Osborn, Jr
Erosion  Erosion of Rocket Nozzles, by Robert  A. Signorelli and James R. Johnston (d)	Fracture, crack propagation Forecasting Fatigue Life of Peened Parts, by H. O. Fuchs	Induction heating The Use of Susceptors in Induction Heating, by Joseph F. Libsch and Pasquale Capolongo 4-77
Explosive bonding Explosive Bonding: Practical Applications May Be Near (tn)	Better Gage Blocks Are Coming (d)6-150  Galvanized steel  New Uses for Galvanized Steel in Auto	Iron  Copper-Cobalt Alloy Strengthens Iron Powder Parts, by E. H. Rennhack 4-93 Refining Molten Iron With Oxygen, by
Explosive forming Explosive Forming Can Cause Problems a Dutch Report, by C. A. Ver- 1-109	Industry (tn) 6-8  Galvanizing  New Continuous Line Turns Out Wide  Galvanized Strip (tn) 1-11	T. C. Churcher (d)

Iron-carbon powder, sintering Vacuum Sintering of Metal Powder Parts, by Anthony J. Zino, Walter E. Jominy and Haroid N. Ipsen 4-88	Metal spraying  How to Deposit Metallic and Nonmetal- lic Coatings With the Plasma Arc Torch, by LeRoy W. Davis	Polishing, electrolytic Industrial Electrolytic Polishing in France, by Robert Mondon1-:
Light metallugry	Microstructure	Powder metal compacts, infiltration Copper-Cobalt Alloy Strengthens Iron Powder Parts, by E. H. Rennhack 4-9
Fracture of Brittle Organic Solids, by Ray W. Guard (c)5-110	Dual Dendrites in a Te-Ag-Sb Alloy, by R. G. R. Johnson 5-107 Microstructures of N155 — Some Added	Powder metal compacts, sintering
Low temperature alloys Compatibility of Metals and Cryogenic Liquids, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell4-100	Notes, by James G. Kerr 5-95 Microstructures of Cast N155 Aged 750 Hr at E'evated Temperatures, by James G. Kerr (ds) 5-96B Milling	Shrinkage of Copper and Iron Powder Compacts During Sintering, by Oleg V. Roman and Henry H. Hausner 2-16 Vacuum Sintering of Metal Powder Parts, by Anthony J. Zino, Walter E. Jominy and Harold N. Ipsen
Structural Alloys for Cryogenic Service, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell	Multi-Head Milling Machine Steps Up Production (tn) 4-7  Molybdenum Rare Earths in Cast Molybdenum, by Ye.	Powder metallurgy Joining Dissimilar Metals, by Wilson B. Tuffin (e)
Alloys, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell5-103	M. Savitskiy, V. V. Barou and T'ao Tsu-ts'ung (d)	Progress in Sintered Aluminum Alloys, by John G. Solomir 1-10
Low temperature applications Welding of Vessels for Low-Tempera- ture Service in Britain, by A. A. Wella 1-90	Welding and Brazing of Tungsten and Molybdenum, by Melvin J. Albom 3-84 Molybdenum alloys	Precipitation hardening Microstructures of N155 — Some Added Notes, by James G. Kerr
Lubricants Lubricants and Fatigue Life, by Erwin V. Zaretsky, William J. Anderson and Richard J. Parker (d)2-168	How to Heat Treat Space Age Materials, by Cecil C. Lacy and Leopold Albertin 3-89 Nickel alloys	Hr at Elevated Temperatures, by James G. Kerr (ds)
New Lubricants for Aluminum (tn) 3-10	Dispersion Strengthened Alloy Available in Sheet Form (tn)	Harry Tanczyn and William C. Clarke, Jr. 6-10 Step Aging of 17-7 PH Stainless Steel,
Machinability Lead and Bismuth Improve Machinability of Aluminum Alloys (tn)	by Ceril C. Lacy and Leopold Albertin 3-89 Machining Heat Treated HS-25 and Inconel Alloy 700 (ds) "Overtemperature" in Nickel Alloys, by	by William A. Token and John J.  Heldt 4-8  Tough New PH steel (tn) 4-8
Machining Machining Heat Treated HS-25 and Inconel Alloy 700 (ds)4-96B	John P. Rowe and J. W. Freeman (d)	Presses Fluid Forming Unit Fits Into Conventional Presses (tn)
Rc 70 High Speed Steel — Its Develop- ment, Properties and Performance, by James R. Handyside, John C. Ham- aker, Jr. and Daniel H. Yates	personic Transport, by Paul H. Denke 3-71 Quenching Nickel Base Sheet in a Fluid- ized Bed, by Ian Astley and Wilfred Merrett (d)	Pressure vessels Compatibility of Metals and Cryogenic Liquids, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James
Machining, electrochemical Electricity in Chemical Machining, by J. A. Cross and C. L. Faust (d)3-179	by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell	F. Watson and William E. Witzell .4-100 Materials for the New Technologies 4-9 Welding of Vessels for Low-Tempera- ture Service in Britain, by A. A. Wells
Magnesium alloys Compatibility of Metals and Cryogenic Liquids, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James	Vacuum Sintering of Metal Powder Parts, by Anthony J. Zino, Walter E. Jominy and Harold N. Ipsen	Properties, predicting Conversion Charts for Time-Temperature Parameters, by David C. Goldberg
E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell4-100 Fabricating and Finishing of Magne- sium Die Castings, by Arthur R. Ti- netti, Elben F. Schultz, Jr. and Leo C. Mangett, Jr	Notch Properties of H11, by Joseph L. Sliney, Jr. (d)2-158  Nuclear reactors Cost of Nuclear Power Continues Down	Quenching Huge Salt Bath Quenches Motor Cases (tn) Quenching Nickel Base Sheet in a Fluid-
Magnesium die castings The Volkswagen Story	Trend (tn) 2-9 Materials for the New Technologies 4-9 Steels for Nuclear Power Reactors, by	ized Bed, by Ian Astley and Wilfred Merrett (d)
Management Technical Management in Action2-64A	Steels for Nuclear Power Reactors (c)6-108  Nuclear reactors, fuel elements	The 200-Series Stainless Steels: High Strength Brings Weight Savings (tn) 5-9 Rare earths
Maraging Cast Maraging Steels Show Promise in Tests (tn)	High Temperature Materials for Nuclear Applications—2, by J. F. Schumar and M. T. Simnad (d) 2-136	Rare Earths in Cast Molybdenum, by Ye. M. Savitskiy, V. V. Barou and T'ao Tsu-ts'ung (d)
Martensite Stresses and Martensite Formation, by M. G. H. Wells and D. R. F. West (d)	Oil refining equipment Protecting an Oil Refinery From Corrosion (d)	Razors Stainless Steel Razor Blades, by Carl A. Moyer (c)
Materials handling equipment	Peening Forecasting Fatigue Life of Peened Parts, by H. O. Fuchs	Refining Molten Iron With Oxygen, by T. C. Churcher (d)6-174
Automatic Conveyor Juggles Big Molds and Castings (sr) ————————————————————————————————————	Pipeline Put the Brakes on Pipeline Designs, by J. Gordon Parr and A. Hanson 5-81	Refractory metals  How to Deposit Metallic and Nonmetallic Coatings With the Plasma Arc
Andrews 5-91 Melting, induction	Plasma arc torch  How to Deposit Metallic and Nonmetal- lic Coatings With the Plasma Arc Torch, by LeRoy W. Davis	Torch, by LeRoy W. Davis3-105 Materials for the New Technologies
Improving Properties by Induction Processes, by Harley F. Gauker	Torch, by LeRoy W. Davis3-105  Plastics Adhesives for Fabricating High Strength	Method, by Arthur G. Metcalfe 5-83 Refractory Metal Sheet Flows From New Plant (tn) 6-7
John M. Edwards 2-74  Metal cutting  Wafering Machine Slices Semiconductor	Structures, by Eugene F. Hess 6-97 Determining Elastic Moduli of Materials by Resonance, by T. W. Gibbs and	Research The Acceleration of Research Benefits, by Allen G. Gray (cp)2-65
Costs (tn) 3-12  Metallographic exhibit	C. L. Theberge 2-97 Materials and Processes Used in Fiat Cars, by Carlo F. Bona 1-66 Materials for the New Technologies 4-9	Rockets  Erosion of Rocket Nozzles, by Robert  A. Signorelli and James R. Johnston (d)
Dual Dendrites in a Te-Ag-Sb Alloy, by R. G. R. Johnson	Materials Progress (tn) 5-10 Materials Progress in Plastics (tn) 2-12 New Challenge in Materials, by Allen G. Gray (cp) 5-65	Materials for Blast Deflectors, by S. R. Locke, H. H. Chandler, P. G. Sayers and E. J. Wheelehan (d)4-170
Radavich and James Osborne 3-82  Metallography	Gray (cp) 5-65 Plastic-Steel Bearing Solves Lubrication Problem (tn) 1-11 Progress in Nonmetallics (tn) 1-12	Rolling Refractory Metal Sheet Flows From
More on Polishing Pyrolytic Graphite, by William C. Coons (c)1-120, (c) 3-114 More on Polishing Pyrolytic Graphite—	Reinforced Plastics in the Avanti Motor  Car (tn) 8-9  Trends in Structural Applications for	New Plant (tn)
and Andrew S. Holik (c)	Reinforced Plastics, by Fred L. Sie- grist 4-97 What Engineers Should Know About Polyolefins, by Mark Bowman and	Salt baths Huge Salt Bath Quenches Motor Cases
(sr)2-108	M. W. Davidson 5-97	(tn) 6-9

Sandwich structure  Brazed Titanium Honeycomb for Service Up to 700 F (tn) 4-8  Low Cost Honeycomb Panels Made From Mild Steel (tn) 3-11	Continuous Casting Geta Real Test in Steel Plant (In)	Tantalum  Continuous Vacuum Process Spurs Thin Film Technology (tw) 5-7 Welding and Brazing of Tantalum and Columbium, by Melvin J. Albom
Semiconductors Facts About Solid State Devices, by Karl F. Smith (d) 5-138 Materials for the New Technologies 4-9 Wafering Machine Slices Semiconductor	grist 2-86  Grain Growth and Vanadium, by D.  Webster and G. B. Allen (d) 6-169  How Various Steels Corrode in Atmospheres, by H. R. Copson (d) 2-172  Low Cost Honeycomb Panels Made From	Tensile strength Calculating the Strength of Steel From Its Analysis, by M. S. Mikhalev and M. I. Gol'dahtein (d)
Coats (tn) 3-12  Shear strength  Correlating Tensile and Shear Strength, by W. E. Creswick (c) 6-108	Mild Steel (tn). 3-11 Pressure Casting of Steel, by Hale H. Hursen 4-67 Principal Steels Used in Heat Treated Parts for German Automobiles, by	Tensile tests  Burst Testing of High Pressure Tubing, by R. C. Angell.  Nondestructive "Tensile Testing" of Cast Iron, by Werner A. Felix
Shearing Forming and Finishing of Range Components at Tappan, by Fred L. Siegrist 2-86	Heinz W. Balster (da)	Cast Iron, by Werner A. Felix
Size measurement Better Gage Blocks Are Coming (d)6-150	A Thermocouple for Molten Steel, by J. Gross and C. B. Griffith (sr)6-106	Tin plate New Mill Rolls "Thin Tin" Plate (tw) 2-11
Solid state devices Facts About Solid State Devices, by Karl	Steel, alloy Burst Testing of High Pressure Tubing,	Titanium Brazed Titanium Honeycomb for Serv-
F. Smith (d)	by R. C. Angell. 6-73 Case Hardening Steels for Gears in Mercedes Cars and Trucks, by Hans Sigwart 1-74 Materials and Processes Used in Fiat	ice Up to 700 F (tn). 4-8 Fast Welding Method Joins Thick-to- Thin Titanium Sections (tn). 1-10 Materials and Fabrication Methods Used in the Gemini Spacecraft, by Homer
Dotts 3-66 Trends in Structural Applications for Reinforced Plastics, by Fred L. Siegrist 4-97	Cars, by Carlo F. Bona	Dotts 3-66 Titanium Welded in Plastic Purge Chamber (tn) 3-10
What the Space Program Can Tell Us About Trends in Welding Alumi- num, by Willis Groth 6-76	J. J. Downs, C. G. Mickelson and H. W. McQuaid 4-72 Steels for Nuclear Power Reactors, by A. L. Medin 3-109	Titanium alloys Compatibility of Metals and Cryozenic Liquids, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James
Specifications High Integrity Castings for Ordnance Applications, by John Schuyten 3-77 How Valid Are Requirements for Non-	Steels for Nuclear Power Reactors (c)6-108 The Volkswagen Story	F. Watson and William E. Witzell4-100 Problems in Selecting Alloys for the Supersonic Transport, by Paul H.
destructive Testing of Welds?, by Jay Bland (ep)	Annealing Blackplate Continuously, by S. Garber (d)	Denke 3-71 Structural Alloys for Cryogenic Service, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F.
Stainless steel The 200-Series Stainless Steels: High Strength Brings Weight Savings (tn) 5-9 Annealing Stainless Strip, by C. A. Gra- ham and G. E. Rowan (d)2-176 Compatibility of Metals and Cryogenic	Tubes, by Carl E. Schoder and David K. Davis 3-97 Problems With Low Carbon Steel Sheet, by Paul G. Nelson (d) 4-154 Steek for Nuclear Power Reactors, by A. L. Medin 3-109	Watson and William E. Witzell
Liquids, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E, Witzell4-100	Steel, free machining Selenium-Leaded Steels Cut Machining	zell
Devising a New Austentitic Stainless, by K. J. Irvine, D. T. Llewellyn and F. B. Pickering (d)	Steel, leaded	Tool steel
Industrial Electrolytic Polishing in France, by Robert Mondon. 1-95 Material Requirements for Vacuum Tubes, by Carl E. Schoder and David	Fatigue Strength of Leaded Steels, by G. W. Brock and G. M. Sinclair (d)4-144 Selenium-Leaded Steels Cut Machining Time (tn)	ment, Properties and Performance, by James R. Handyside, John C. Hannaker, Jr. and Daniel H. Yates 6-78 Sampling Molten Tool Steels, by B. H. Senior (sr)
K. Davis  Pickling and Descaling Stainless Steels and High Temperature Alloys, by John A. Gurklis and L. D. McGraw 6-95  Pickling Stainless Steels and High Tem-	Cast Maraging Steels Show Promise in Tests (tn) 2-10  Steel, precipitation hardening	Tubing Burst Testing of High Pressure Tubing, by R. C. Angell Tungsten Tubing Extruded in Molybde-
perature Alloys, by John A. Gurklis and L. D. McGraw (ds)	Tough New PH Steel (tn) 4-7  Steel, temperature measurement  A Thermocouple for Molten Steel, by J.  Gross and C. B. Griffith (tr) 6-106	Tungsten Tungsten Coatings Applied by Vapor
Problems in Selecting Alloys for the Supersonic Transport, by Paul H. Denke 3-71 Steels for Nuclear Power Reactors, by A. L. Medin 3-109	Steelmaking Metal Production in India, by B. R. Nijhawan	Process (tn) 3-12 Tungsten Tubing Extruded in Molybdenum Jacket (tn). 6-8 Welding and Brazing of Tungsten and
Steels for Nuclear Power Reactors (e)6-108 Structural Alloys for Cryogenic Service, by Jack L. Christian, James E.	Steelmaking, open hearth Basic Oxygen Steel How Does It Measure Up? by Donald J. Wulpi 6-67	Molybdenum, by Melvin J. Albom 3-84  Vacuum melting Big Vacuum Melting Furnace Nears Completion (ts) 6-10
Chafey, Abraham Hurlich, James F. Watson and William E. Witzell3-101 A Study of Brittle Fracture in Cryogenic Alloys, by Jack L. Christian, James E. Chafey, Abraham Hurlich, James F. Watson and William E. Witzell5-103	Steelmaking, oxygen furnace process Basic Oxygen Steel How Does It Measure Up? by Donald J. Wulph 6-67 Making Oxygen Steel From Cupola	Vacuum processing Descaling by Vacuum Annealing, by E. Ergang and P. H. Huppertz (d)6-171
Stainless steel, precipitation hardening New PH Steel Matches Strength and Toughness, by D. Cameron Perry,	Making Oxygen Steel From Cupola Product, by E. R. Richards (d)	Vacuum sintering Vacuum Sintering of Metal Powder Parts, by Anthony J. Ziro, Walter E. Jominy and Harold N. Ipsen
Harry Tanczyn and William C. Clarke, Jr	Steelmaking (tn) 5-8  Stress-rupture tests Conversion Charts for Time-Tempera-	Vanadium  Grain Growth and Vanadium, by D.  Webster and G. B. Allen (d)6-167
Stainless steel powder, sintering Vacuum Sintering of Metal Powder Parts, by Anthony J. Zino, Walter E. Jominy and Harold N. Ipsen	Conversion Charts for Time-Tempera- ture Parameters, by David C. Gold- berg	Waste disposal Sewage and Metal Finishing Waste, by Leslie E. Lancy (d)
iteel	Stresses and Martensite Formation, by M. G. H. Wells and D. R. F. West (d)	Wear Wear in Metals, by Robert H. Read (d)4-158
Basic Oxygen Steel How Does It  Measure Up? by Donald J. Wulpi 6-67  Calculating the Strength of Steel From  Its Analysis by M. S. Mikhalay and	Strip Correcting Strip Shape, by P. Brock, J. E. Bowers and D. D. Smith (d)4-179	Welding Fast Welding Method Joins Thick-to- Thin Titanium Sections (2n)
M. I. Gol'dshtein (d). 6-170 Carburizing "T-1" Constructional Steel, by Bernard Trock and John Vettraino 5-79 Chromium Plated Steel for Cass a Japanese Innovation, by Hiromu Uchida and Akira Horiguchi	Superconductivity Facts About Solid State Devices, by Karl F. Smith (d)	Forming and Finishing of Range Com- ponents at Tappan, by Fred L. Sie- grist 2-86 Materials and Fabrication Methods Used in the Gemini Spacecraft, by Homer Dotts 3-66

Naturally Aging Aluminum Alloy Remains Strong When Welded (tn)	2-13
Thick Aluminum Plates Welded in Two Passes (tn)	
Titanium Welded in Plastic Purge Chamber (tn)	3-10
Welding and Brazing of Tantalum and Columbium, by Melvin J. Albom	4-82
Welding and Brazing of Tungsten and Molybdenum, by Melvin J. Albom	
Welding of Vessels for Low-Tempera- ture Service in Britain, by A. A.	
Wells	1-96
What the Space Program Can Tell Us About Trends in Welding Alumi-	6-76

Welding, consumable Consumable Weld Inserts Take dustrial Jobs (tn)		5
Welding, explosive		
Explosive Forming Can Cause lems a Dutch Report, by Verbraak	C. A.	-1

Verbraak	***************************************	1-109
Weld tests	Are Requirements for Non-	
	e Testing of Welds? by Jay	4-65

Wiredrawi	ng, ultr	a	onic			
Ultrasonie	Energy:	8	Tool	for	Forming	
Metals?	(tn)					6-1

	strength					_	
Calcu	lating the	Str	rength	of	Steel	From	
Its	Analysis,	by	M. S.	M	ikhale	v and	
	I. Gol'dshi						5-170

Zinc, fir	nis	hing				
Surface	Pr	otection	With	Chromate	Coat-	
ings,	by	Walter	E. P	ocock		6-83

ne m	elti	ng					
Using							
ment,	by	Steve	en D.	Hurw	itt ar	nd M	al-
colm	Α.	Adam	16				2-101

### **Author Index**

Adams, Malcolm A. Albertin, Leopold Albom, Melvin J. Allen, G. B. (d) Anderson, William J. (d) Andrews, Donald E. Angell, R. C. Astley, Ian (d) Austin, James B.	2-101
Albertin Leonald	3.89
Albom Melvin J 3-8	4 4-82
Allen C R (d)	6-167
Andomon William I (d)	2-168
Andrews Deneld F	5.01
Andrews, Donald E	0.70
Angell, R. C.	6-73
Astley, Ian (d)	3-166
Austin, James B	5-67
Balster, Heinz W. (ds)	1-96B
Bardgett, W. E. (d)	5-153
Barou, V. V. (d)	6-158
Rishon Tom (d)	1-156
Bland Jay (en)	4-65
Bone Carlo F	1-66
Poeth E E (d)	9 174
Pomens I F (d)	4.170
Dowers, J. E. (a)	4-113
Bowman, Mark	0-97
Brassard, Theresa V. (c)	1-120
Brock, G. W. (d)	4-144
Brock, P. (d)	4-179
Buchanan, J. G. (d)	1-170
Budd, M. K. (d)	2-174
Balster, Heinz W. (ds) Bardgett, W. E. (d) Barou, V. V. (d) Bishop, Tom (d) Bland, Jay (ep) Bona, Carlo F. Booth, F. F. (d) Bowers, J. E. (d) Bowman, Mark Brassard, Theresa V. (e) Brock, G. W. (d) Brock, P. (d) Buehanan, J. G. (d) Budd, M. K. (d)	
Canolongo Pasquale	4.77
Chafey James F	2 101
Charey, James E.	.0-101.
4-100	, D-103
Chandler, H. H. (d)	4-170
Child, H. C.	6-90
Christian, Jack L.	3-101.
4-100	, 5-103
Churcher, T. C. (d)	6-174
Clarke, William C., Jr.	6-101
Coons, William C. (c)	.1-120.
(e)	3-114
Copson H R (d)	2-172
Creewick W E (e)	6-108
Cross I A (d)	9 170
Capolongo, Pasquale Chafey, James E. 4-100 Chandler, H. H. (d) Child, H. C. Christian, Jack L. 4-100 Churcher, T. C. (d) Clarke, William C., Jr. Coons, William C. (c) Copson, H. R. (d) Creswick, W. E. (e) Cross, J. A. (d)	0-110
Davidson, M. W. Davis, David K. Davis, LeRoy W. Denke, Paul H. Denning, R. E. (d) Dotts, Homer Downs, J. J.	
Davidson, M. W.	0-97
Davis, David K	3-97
Davis, LeRoy W.	3-105
Denke, Paul H	3-71
Denning, R. E. (d)	4-174
Dotts, Homer	3-66
Downs, J. J.	4-72
Edwards, John M Ergang, E. (d)	2-74
Franc F (d)	6.171
E C I (1)	0 170
raust, C. L. (d)	3-179
Felix, Werner A.	2-91
Freeman, J. W. (d)	6-159
Faust, C. L. (d)	5-75
Garber, S. (d)	6-156
Gauker Har'ev F	2-78
Gibbs T W	2-97
Goldberg David C	COLUMN TO E
3.96 (4.1	3-96B
Col'debtein M I (d)	6-170
Croham C A (d)	"A.TIA
Granam, C. A. (d)	9 176
	.2-176
Gray, Allen G. (cp)	1-65,
3-65, 5-65	2-176 1-65, , 6-65
Garber, S. (d)	2-176 1-65, , 6-65 6-106

Gross, J. (ar)	6-10
Groth, Willis	6-7
Gross, J. (sr)	6-961
Hamaker John C. In	6.7
Handwide James R	6-71
Hanson A.	5-8
Hartner, Elizabeth P. (d)	_6-136
Hausner, Henry H	2-10
Heintzelman, E, F. (e)	4-106
Heldt, John J.	4-86
Hess, Eugene F.	6-97
Hodge, L. A. (d)	2-151
Holik, Andrew S. (c)	1-120
Horiguchi, Akira	6.171
Huslich Absolute	9.101
A-100	S-105
Hursen Hale H	4-67
Hamaker, John C., Jr.  Handyside, James R.  Hanson, A.  Hartner, Elizabeth P. (d).  Hausner, Henry H.  Heintzelman, E. F. (e).  Heldt, John J.  Hess, Eugene F.  Hodge, L. A. (d).  Holik, Andrew S. (c).  Horiguchi, Akira.  Huppertz, P. H. (d).  Hurlich, Abraham.  4-100,  Hursen, Hale H.  Hurwitt, Steven D.	2-101
I II11 N	4 80
Ipsen, Harold N Irvine, K. J. (d)	4 190
Johnson R G R	B-107
Johnston, James R. (d)	6-165
Johnston, R. G. R.  Johnston, James R. (d)  Jominy, Walter E.	4-88
Kenn James C 5-06 (da)	5 0cb
Kedzie, Donald P. (d)	6-88
Lacy Caril C	9.80
Ladroga William J. Jr. (ar)	2-108
Lancy, Leslie E. (d)	5-157
Libsch, Joseph E	4-77
Littmann, W. E. (d)	5-159
Llewellyn, D. T. (d)	.4-136
Locke, S. R. (d)	4-170
Lockeman, G. F. (c)	.2-110
Lacy, Cecil C. Ladroga, William J., Jr. (sr) Lancy, Leslie E. (d) Libsch, Joseph E. Littmann, W. E. (d) Llewellyn, D. T. (d) Locke, S. R. (d) Lockeman, G. F. (c) Lorking, K. F. (d)	.4-150
Mangett, Leo C., Jr	2-67
McGrath, J. T. (d)	.1 - 170
McGraw, L. D 6-95, (ds)	6-96B
McQuaid, Harry W(c) 2-110	: 4-72
Medin, A. L.	8-109
Merrett, Wilfred (d)	3-166
Metcalle, Arthur G	4.79
Mikheley M S (d)	6.170
Mondon Robert	1-95
Moyer, Carl A.	
Mangett, Leo C., Jr	5-159
Nelson, Paul G. (d)	4-154
Nelson, Paul G. (d) Nijhawan, B. R	
Oshorn, Harry B., Jr	2-89
Osborn, Harry B., Jr. Osborne, James	3-82
Parker, Richard J. (d)	Z-168
Parr, J. Gordon	6.101
Pickering F R (d)	4-136
Parker, Richard J. (d) Parr, J. Gordon Perry, D. Cameron Pickering, F. B. (d) Pocock, Walter E.	6.83
rocock, waiter E.	

Radavich, John F	3-82
Road Robert H (d)	4-158
Roinke Charles F (c)	3-114
Rennhack E H	4-93
Rice S I. (d)	4-174
Richards E R (d)	4-162
Roman Oleg V.	2-104
Rowan G E (d)	2-176
Read, Robert H. (d) Reinke, Charles F. (c) Rennhack, E. H. Rice, S. L. (d) Richards, E. R. (d) Roman, Oleg V. Rowan, G. E. (d) Rowe, John P. (d)	6-159
Savitskiy, Ye. M. (d)	6-158
Savers, P. G. (d)	4-170
Schoder, Carl E.	3-97
Schultz, Elben F., Jr.	2-67
Schumar, J. F. (d)	2-136
Schuyten, John	3-77
Seidel, R. A	5-87
Senior, B. H. (sr)	5-108
Seyb, Edgar, Jr. (d)	6-163
Siegrist, Fred L2-8	6, 4-97
Signorelli, Robert A. (d)	6-165
Sigwart, Hans	1-74
Simnad, M. T. (d)	2-136
Sinclair, G. M. (d)	4-144
Sliney, Joseph L., Jr. (d)	2-158
Smith, D. D. (d)	4-179
Smith, Karl F. (a)	5-138
Solomir, John G.	-1-105
Stanners, J. F. (a)	0-100
Schuyten, John Seidel, R. A. Senior, B. H. (sr) Seyb, Edgar, Jr. (d) Siegrist. Fred L. 2-8 Signorelli, Robert A. (d) Sigwart, Hans. Simnad, M. T. (d) Sinclair, G. M. (d) Sliney, Joseph L., Jr. (d) Smith, D. D. (d) Smith, Karl F. (d) Solomir, John G. Stanners, J. F. (d) Stover, Edward R. (c)	0-112
Tanczyn, Harry	6-101
Thurston, R. C. A. (d)	1-170
Theberge, C. L.	2-97
Tinetti, Arthur R.	2-67
Token, William A	4-86
Trock, Bernard	5-79
Tsu-ts'ung, Tao (d)	6-158
Tanczyn, Harry Thurston, R. C. A. (d) Theberge, C. L. Tinetti, Arthur R. Token, William A. Trock, Bernard Tu-ta'ung, Tao (d) Tuffin, Wilson B. (c)	6-110
Uchida, Hiromu	1-113
Verbraak, C. A Vettraino, John	1-109
Vettraino, John	5-79
Watson, James F.  Webb, James E. (c) Webster, D. (d) Wels, A. A. Wells, M. G. H. (d) West, D. R. F. (d) West Dook, J. H. (d) Westhook, J. H. (d) Westhook, J. H. (d) Westlake, D. G. (c) Wheelehan, E. J. (d) Witzell, William E.  3-101, 4-100, Wood, D. L. (d) Wulpi, Donald J.	
3-101, 4-100,	5-103
Webb, James E. (c)	2-110
Webster, D. (d)	6-167
Wells, A. A.	1-90
Wells, M. G. H. (d)	1-172
West, D. R. F. (d)	1-172
Westbrook, J. H. (d)	6-142
Westlake, D. G. (c)	6-108
Witzell William E.	4-170
3-101, 4-100,	5-103
Wood, D. L. (d)	.6-142
Wulpi, Donald J Wyss, Urs	6-67
Wyss, Urs	1-86
Yates, Daniel H Yorke, David G	6-78
Yorke, David G.	.2-96.
(ds) 2-96B, (c)	4-106
Zaretsky, Erwin V. (d) Zimmer, F Zino, Anthony J	.2-168
Zimmer, F	.1-101
Zino, Anthony J	4-88

## METAL PROGRESS

THE MAGAZINE OF MATERIALS AND PROCESS ENGINEERING

## Volume 84 July 1963 through December 1963

ALLEN G. GRAY, Editor; Editor, Periodical Publications, ASM

RALPH G. DERMOTT, Managing Editor

CARL R. WEYMUELLER
Associate Editor

ELIZABETH M. ALDRICH Assistant Editor FRED L. SIEGRIST
Associate Editor

FLOYD E. CRAIG
Art Director



Metal Progress Is Owned and Published by

THE AMERICAN SOCIETY FOR METALS
Metals Park, Ohio

#### Subject Index

The subject headings used in this index are chosen in accordance with the ASM-SLA Metallurgical Literature Classification, International (Revised) Edition, published by the American Society for Metals, 1958.

Alloy steel Alloy Machinery Steels in Retrospect, by Edgar C. Bain	Anodizing Military Plating Specifications—II (ds) 3-106	Bronze, finishing Chromate Coatings for Protecting Non- ferrous Metal Surfaces, by Walter E.
Controlling the Case Hardening of Pre- cision Parts, by Nicholas P. Milano 5-78	Antimony Preparing Bismuth and Antimony for Metallographic Examination, by Wil-	Pocock1-10
Cooling Transformation Diagram for AISI 3140	liam C. Coons6-120	Chromate Coatings for Protecting Non- ferrous Metal Surfaces, by Walter E. Pocock
Cooling Transformation Diagram for AISI 4047	Arc cutting Cutting With Plasma Jets, by R. L. O'Brien and R. J. Wickham (d)6-180	Pocock 1-10 Delayed Brittle Failure in Cadmium Plated Stee's, by Walter Beck and Edward J. Jankowsky. 2-9 Military Plating Specifications—I (ds). 2-10
The Fifth Stage of Tempering, by August Kasak, Vijay K. Chandhok and Edward J. Dulis	Austempering Austempering Medium Carbon Steel, by Romeo L. Suffredini	Carbonitriding
High Vacuum Dezassing With Induc- tion Stirring Makes Cleaner Steels, by Thomas E. Perry	Modern Heat Treating Practices4-105	Modern Heat Treating Practices4-10 Carbon steel
How Inclusions Affect Ductility of Steel Forgings, by David E. Austin and Donald D. Goehler	Automobiles The Automotive Gas Turbine, by Amedee Roy, Claude Belleau and Frederick A. Hagan	Austempering Medium Carbon Steel, by Romeo L. Suffredini
Military Plating Specifications—II (ds) 3-106	cision Parts, by Nicholas P. Milano 5-78 Evolution of Chromium Plating of Automotive Hardware, by Charles Melekian, John Tierney and James	Carburizing 2-10
Seen and Heard at ASM's Metalwork- ing Exhibition and Technical Sessions in Milwaukee (tn)	H. Lindsay4-167 French Experience With Continu-	Modern Heat Treating Practices4-10
Aluminum	ously Cast Steels for Automotive Parts, by Michel Misson and Jacques Pomey 4-123	Case hardening Controlling the Case Hardening of Pre- cision Parts, by Nicholas P. Milano 5-71
Aluminum Extrusions Get Transverse Detail (tn)	Materials Selection in the Auto Industry 4-152 New Corrosion Test for Stainless Auto	Casting
Chromate Coatings for Protecting Non- ferrous Metal Surfaces, by Walter E. Pocock 1-100	Trim, by Robert M. Fowler and Claude R. Bishop	Melting and Casting Beryllium, by John P. Denny and William H. Santschi1-11 Steel Slabs Cast by Pressure Pouring
Closing the Metal Gap, by Walter L. Finlay and Joseph R. Lane	Aluminum-Plastic Bearing Rings, by Joseph W. Schuster	Strong Aluminum Casting Alloys Unveiled (tn)
Gas Process Plates Aluminum on Copper (tn). 6-9 Intergranular Corrosion of High Strength Aluminum, by S. J. Ketch-	Beryllium Closing the Metal Gap, by Walter L.	Casting, centrifugal Seen and Heard at ASM's Metalwork- ing Exhibition and Technical Sessions in Milwaukee (tn)
am and W. Beck (d)	Finlay and Joseph R. Lane	Casting Continuous Casting Slabs Continuously, by P. Desfosses (d)
Strain Hardening in Copper and Alu- minum, by F. P. Bullen and M. M. Hutchison (d)3-164	Special Metals, by John A. Gurklis and L. D. McGraw (ds)1-106  Bismuth	French Experience With Continu- ously Cast Steels for Automotive Parts, by Michel Misson and Jacques
Vacuum Lowers Fatigue Strength of Aluminum (tn)	Preparing Bismuth and Antimony for Metallographic Examination, by Wil- liam C. Coons6-120	Pomey
Aluminum alloys Aluminum-Plastic Bearing Rings, by	Bonding, diffusion	Castings
Joseph W. Schuster	Unusual Joining Techniques, by Robert C. Bertossa (d)5-152	Determining Quality in Castings, by A. G. Fuller, P. J. Emerson and R. Rew (d)
Faster Than 6061 (tn) 2-9	Brass Case Histories of Materials Failure, by	Cast iron Graphitization in Cast Iron, by B.
Introducing Two Weldable Aluminum Alloys: 74S and C74S, by Ian Taylor 5-74 Military Plating Specifications—II (ds) 3-106	Paul Ogden	Walker and V. Kondic (d) 3-180 Induction Units Replace Cupolas in New Iron Foundry (tn) 3-7 Modern Heat Treating Practices (4.100
Modern Heat Treating Practices4-111 Peening Increases Fatigue Strength of Welded Aluminum, by G. E. Nord-	Pocock	Modern Heat Treating Practices4-109 Ceramics
mark 5-101 Secregation in Al-Zn-Mg Alloys, by G. T. Rogers and D. E. Glanville (d)	Brazing Brazing Strengthens Weldments in Stator Rings (In)	Fabricating and Joining High Strength Ceramics, by Robert E. Lintner, Vladimir E. Wolkodoff, Laurence E. Ferreira and L. Coulson Hageman
Strong Aluminum Casting Alloys Un- veiled (tn) 1-8	Brittleness Embritlement of Copper, by S. Harper, V. A. Callcut, D. W. Townsend and	New Horizons for Ceramics, by Allen G. Gray (ep)
Annealing Induction Heating Speeds Up Continu-	Hydrogen Embrittlement in Copper by	by Robert E. Lintner, Vladimir E. Wolkodoff, Laurence E. Ferreira and L. Coulson Hageman5-109
ous Annealing of Strip (tn)	S. Harper, V. A. Calleut, D. W. Townsend and R. Eborall (d)3-178	Outlook for High Temperature Materials 4-112

Chromate coatings Chromate Coatings for Protecting Non- ferrous Metal Surfaces, by Walter E. Pocock	Documentation  How to Keep Informed Today, by Walter L. Fleischmann	Flaw detection, magnetic particle Magnetic Particle Testing Detects Microcracks in Forgings, by John F. Hildebrand2-9:
Chromium, electroplating of Evolution of Chromium Plating of Auto- motive Hardware, by Charles Mele- kinn, John Tierney and James H. Lindsay	Drawing Difficult to Form Sheet, by Harry P. Schane and James Herring (d)	Flaw detection, nondestructive  Meeting the Challenge of Change in Nondestructive Testing
Military Plating Specifications—I (ds)2-106  Chromizing Chromium Case on Steel Strip Fights Corrosion and Heat (tn)	How Inclusions Affect Ductility of Steel Forgings, by David E. Austin and Donald D. Goehler	Flaw detection, penetrant  How to Use Liquid Penetrant Tests, by Wallace J. Erichsen and George W. Billings, Jr
Coatings  Boron Nitride Coatings for Metals and Nonmetals (in)	An Advanced Technology: Our Most Valuable Resource, by Allen G, Gray (cp)	Flaw detection, ultrasonic Testing Steel Plates Ultrasonically, by W. Dick, P. Hoeller and E. Lachky (d)
Mosley and Terry C. Wallace (d) 6-178 Outlook for High Temperature Materials 4-112 What the Navy Needs, by Robert C. Bertossa (d) 2-134	by Allen G. Gray (cp).  Meeting the Challenge of Change in Technology for Profits and Growth by Allen G. Gray (cp)	Fluid bed Epoxy Insulation Applied in Fluidized Bed (tn)
Cobalt alloys Properties of a Cobalt Alloy, by Philip A. Clarkin, John W. Weeton and Paul F, Sikora (d)	Electric induction furnaces	Working With Maraging Steels
Columbium Closing the Metal Gap, by Walter L. Finlay and Joseph R. Lane	Induction Units Replace Cupolas in New Iron Foundry (ts)	ings, by Joseph J. Warga 3-109 Vertical Furnace Keeps Forgings Straight (tn) 3-9
Construction equipment Columbium Treated Steel Improves Construction Equipment, by Gordon H. Walter	Electron microscopy  Anomalies in Electron Micrographs by	Forming Advances in Production Engineering (d) 6-146 Navy Announces Study Program for Hard-to-Work Metals (fs) 2-8
Copper Chromate Coatings for Protecting Non- ferrous Metal Surfaces, by Walter E.	D. A. Ryder, C. A. Stubbington and R. Vian (sr).  More on "Anomalies in Electron Micro- graphs", by Guy V. Bennett and Austin Phillips (c)	Forming, low temperature  Seen and Heard at ASM's Metalworking Exhibition and Technical Sessions in Milwaukee (#n)
Pocock 1-100  Embrittlement of Copper, by S. Harper, V. A. Callcut, D. W. Townsend and R. Eborall (d) 1-152  Foamed Nickel and Copper Show Un-	Engineering Applications for Precious Metal Plating, by D. Gardner Foulke6-107 Electroplating, nickel	Free-machining steel  Meeting the Challenge of Change in Steels, by Carl R. Weymueller4-126
usual Properties (tn) 1-8 Gas Process Plates Aluminum on Copper (tn) 6-9 Greater Purity for Oxygen-Free Copper (sr) 6-124	Corrosion Resistant Bright Nickel Plate Unveiled (tn) 2-8  Explosive bonding Explosively Clad Plate for Commercial	Ghosts  Along Came a Spider, by Robert J.  Eule (c)
Hydrogen Embrittlement in Copper, by S. Harper, V. A. Calleut, D. W. Townsend and R. Eborall (d)	Use (tn) 5-7  Explosive forming Progress in Aerospace Technology, by Robert C. Bertossa (d) 1-138	Ole J. Krudtan (c)
Copper alloys Materials Selection in the Auto Industry 4-152 Modern Heat Treating Practices 4-109	Extrusion Aluminum Extrusions Get Transverse Detail (tn)	Hardness tests  How to Determine Case Depths by Hardness Tests, by Melvin C. Vagle, Jr
Corresion	Improved Aluminum Alloy Extrudes Faster Than 6061 (tn)	Heat resisting alloys
Case Histories of Materials Failure, by Paul Ogden 1-93 Corrosion Control by Materials Selection, by Carl H. Samans 3-74 Durable Dock Filings of Aluminum, by	Lucckerath and Georg Gebauer 2-81 Progress in Extruding Steel With Gluss Lubricants, by R. Hubert and H. Thannberger 2-74	The Automotive Gas Turbine, by Amedee Roy, Claude Belleau and Frederick A. Hagan. 4-137 Closing the Metal Gap, by Walter L. Finlay and Joseph R. Lane. 3-79 How Hydrogen Affects Some Alloys, by S. K. Klima, A. J. Nachtigall and
Gilbert S. Schaller (sr)	Fabrication Navy Announces Study Program for Hard-to-Work Metals (in)	How Hydrogen Affects Some Alloys, by S. K. Klima, A. J. Nachtigall and C. A. Hoffman (d) 2-161 Modern Heat Treating Practices 4-110 Outlook for High Temperature Materials 4-112 René 62: A Strong Superalloy for
Corrosion, biological What the Navy Needs, by Robert C.	Delayed Brittle Failure in Cadmium Plated Steels, by Walter Beck and Edward J. Jankowsky	terials 4-112  René 62: A Strong Superalloy for Welded Structures, by H. Thomas McHenry, James F. Barker and Ralph J. Stuligross 6-86  Selecting Conveyor Belts for High Tem-
Bertossa (d)2-134  Corrosion tests	Fatigue tests, ultrasonic Predicting Fatigue Failure With Ultra- sonies, by Jens Gert Rasmussen (d)5-168	perature Service, by Edwin Shuttleworth (c)
New Corrosion Test for Stainless Auto Trim, by Robert M. Fowler and Claude R. Bishop	Finishing Introducing Two Weldable Aluminum Alloys: 74S and C74S, by Ian Taylor. 5-74 A New Look at Vibratory Finishing, by W. E. Brandt 5-96	Heat treating furnaces Vertical Furnace Keeps Forgings Straight (tn) 3-9
Cutting tools Advances in Production Engineering (d)	Flaw detection  Determining Quality in Castings, by  A. G. Fuller, P. J. Emerson and R.	Heat treatment Austempering Medium Carbon Steel, by Romeo L. Suffredini 3-85 Characteristics of Induction Hardened
Degassing High Vacuum Degassing With Induction Stirring Makes Cleaner Steels, by Thomas E. Perry 2-88 New Degassing Process Helps Double Bearing Life (tn) 2-10	Inspecting With Filtered and Electrified Particles, by E. T. Hughes and D. R. Powers 5-85 Testing Filament Wound Missile Cases, by Carl R. Weymueller 3-113	Axles, by Richard K. Wuerfel. 6-93 Controlling the Case Hardening of Precision Parts, by Nicholas P. Milano The Fifth Stage of Tempering, by August Kasak, Vijay K. Chandhok and Edward J. Dulis 5-82 Heat Treatment and Properties of 748 Aluminum by Han, Taylor 6-96
Die casting Problems in Making Die Castings of	Thermographic Methods for Special Applications, by N. L. Carroll	How to Determine the Quench Severity
Steel, by V. M. Belov and S. A. Kazennov (d) 3-161	Eddy Current Test Measures Thickness of Plastic Heat Shield (tn)	of Oil and Salt Baths, by Warren F. Rushman 6-91

Modern Heat Treating Practices4-102 New Heat Treatments for Inconel X-750, by Herbert L. Eiselstein and Robert E. Crickmer5-116	Magnesium Chromate Coatings for Protecting Non- ferrous Metal Surfaces, by Walter E.	Peening Peening Increases Fatigue Strength of Welded Aluminum, by G. E. Nord- mark
Heat treatment, controlled atmosphere Modern Heat Treating Practices	Pocock Closing the Metal Gap, by Walter L. Finlay and Joseph R. Lane	Phosphate coatings Military Plating Specifications—II (de)3-10
Demoulin 2-77	Military Plating Specifications—II (ds)_3-106	Pipe
High energy rate forming HERF Machine Forges Parts for Outboard Motors (sr)	Martempering Modern Heat Treating Practices4-105	Consumable Insert Rings for Better Pipe Welds, by Helmut Thielsch
High strength steel	Materials Let's Use Today's Materials, by Carl	
Measuring Stress in Steel Parts by X-Ray Diffraction, by Donald A. Bol- stad, Robert A. Davis, William E. Quist and Earl C. Roberts	H. Samans (ep) 3-73  Materials handling equipment Selecting Conveyor Belts for High Temperature Service, by Edwin Shuttleworth (c) 5-126	Plasma processing Cutting With Plasma Jets, by R. L. O'Brien and R. J. Wickham (d)
High temperature steel	Shuttleworth (c)5-126	Plastic deformation
A Stainless Steel for High Temperature Service, by Edward L. Bedell, Thad T. Rick and Donald J. Beerntsen 1-96	Melting Melting and Casting Beryllium, by John P. Denny and William H. Santschi1-111	How Swaging Affects Mechanical Properties of Steel, by Romeo L. Suffredini
Hydrogen	Metallographic exhibit	Plastics Eddy Current Test Measures Thickness
How Hydrogen Affects Some Alloys, by S. K. Klima, A. J. Nachtigall and C. A. Hoffman (d)2-161	Preparing Bismuth and Antimony for Metallographic Examination, by Wil- liam C. Coons	of Plastic Heat Shield (tn) 3-8 Epoxy Insulation Applied in Fluidized
Inclusions	Metallography Anomalies in Electron Micrographs, by	Bed (tn) 1-10 Laminated Plastics Specified for Jet Airliners (tn) 5-9 PVC as a Mounting Compound, by G.
How Inclusions Affect Ductility of Steel Forgings, by David E. Austin and	D A Ruder C A Stubbington and	PVC as a Mounting Compound, by G. L. Gibbon and John V. Furth (c)3-118
Donald D. Goehler	R. Vian (sr). 2-111 More on "Anomalies in Electron Micrographs", by Guy V. Bennett and Austin Phillips (c)	Plastics, acetal What Engineers Should Know About
Characteristics of Induction Hardened Axles, by Richard K. Wuerfel	Metallography, specimen preparation	Acetal Resins, by John D. Young4-162
Induction heating	A Conductive Metallographic Mount, by E. W. Filer and J. P. Smith (c)	Plastics, nylon Materials Progress (tn)
Induction Heating Speeds Up Continuous Annealing of Strip (tn) 3-8	don Hoffman (c)3-118  PVC as a Mounting Compound, by G. L. Gibbon and John V. Furth (c)3-118	Plastics, phenoxy Phenoxy A New Engineering Plastic, by Fred L. Siegrist
Advances in Production Engineering (d)	Metal spraying Research on Metal Spraying, by W. E. Ballard (d)	Plastics, polycarbonate Aluminum-Plastic Bearing Rings, by
Iron alloys The Automotive Gas Turbine, by Ame-		Joseph W. Schuster
dee Roy, Claude Belleau and Frederick A. Hagan 4-137 Military Plating Specifications—II (ds) 3-106	Metalworking The Metalworking Industry What	Kunze 2-99
Military Plating Specifications-II (ds)_3-106	Lies Ahead?, by Allen G. Gray 4-7	Powder metal compacts, sintering Vacuum Sintering and Coining Give
Iron and steelmaking High Vacuum Degassing With Induc- tion Stirring Makes Cleaner Steels, by Thomas E. Perry	Milling Pinion Gears Milled and Centered on Combination Machine (tn)	Ductile Powder Compacts (tn) 6-8  Precious metals
by Thomas E. Perry 2-88	Milwaukee Metalworking Exhibition	Engineering Applications for Precious Metal Plating, by D. Gardner Foulke 6-107
Unusual Joining Techniques, by Robert C. Bertossa (d)	Seen and Heard at ASM's Metalwork- ing Exhibition and Technical Sessions in Müwaukee (tn)	Pressure vessels
Lasers Seen and Heard at ASM's Metalwork- ing Exhibition and Technical Sessions	Missile cases, flaw detection Testing Filament Wound Missile Cases, by Carl R. Weymueller	Big Pressure Vessel Made From De- gassed Steel (th)
in Milwaukee (tn) 1-7	Molybdenum	Quenching
Light metallurgy Ponderosium: Stable Heavyweight?, by Donald B. Hunter (c)1-116	Closing the Metal Gap, by Walter L. Finlay and Joseph R. Lane	How to Determine the Quench Severity of Oil and Salt Baths, by Warren F. Rushman 6-91 Modern Heat Treating Practices 4-107
Lubricants	Nickel	Quenching media
Lubrication in Outer Space, by W. A. Glaeser (d) Phosphate Lubricants for Hot Forming of Metals, by Georg Graue, Werner Lucekerath and Georg Gebauer. 2-81	Corrosion Resistant Bright Nickel Plate Unveiled (tn) 2-8 Evolution of Chromium Plating of Automotive Hardware, by Charles	How to Determine the Staining Ten- dencies of Quenching Oils, by G. R. Furman 2-85
	Melekian, John Tierney and James H. Lindsay 4-167	Razors  More on Stainless Steel Razor Blades,
Lubricants, glass Progress in Extruding Steel With Glass Lubricants, by R. Hubert and H. Thannberger2-74	Foamed Nickel and Copper Show Un- usual Properties (tn)	by W. J. O'Leary (c)2-118 Railroad cars
	Nickel alloys	Strong Steels Trim Weight of Hopper Cars (tn) 6-9
Machinability Special Ferromanganese for Free- Machining Steels (tn)	New Heat Treatments for Inconel X-750, by Herbert L. Eiselstein and Robert E. Crickmer	Refractories Deterioration of Stabilized Zirconia, by John D. Buckley (d)2-158
Machining Advances in Production Engineering	Nitriding	
(d)	Working With Maraging Steels Nitriding, by John B. Seabrook 1-78	Refractory metals Extruding Refractory Metals, by I. Perlmutter and Vincent DePierre 5-90
Milwaukee (tn) 1-7	Nuclear reactors, corrosion What the Navy Needs, by Robert C.	Outlook for High Temperature Ma- terials 4-112
Machining, electrical discharge New Machining Methods Trim Tool and	What the Navy Needs, by Robert C. Bertossa (d)2-134  Painting	Pickling and Descaling Refractory and Special Metals, by John A. Gurklis and L. D. McGraw (ds)
Die Costs, by Ralph G. Dermott4-181	What the Navy Needs, by Robert C. Bertossa (d) 2-134	Progress in Aerospace Technology, by Robert C. Bertossa (d)
Machining, electrochemical Electrochemical Drilling, by Walter B.	Palladium	What the Navy Needs, by Robert C. Bertossa (d)2-134
Kleiner (d)	Deposits for Electrical Contacts, by H. C. Angus (d)3-188	Rhodium, electroplating of Military Plating Specifications—I (ds)2-106

Rolling Metals in a Vacuum, by Ya. B. Gurevich (d) 2-157  Ships What the Navy Needs, by Robert C. Bertosaa (d) 2-134	Steel forgings  How Inclusions Affect Ductility of Steel Forgings, by David E. Austin and Donald D. Goehler	Tungsten   Closing the Metal Gap, by Walter L.   Finlay and Joseph R. Lane   S-75
Silver, electroplating of Military Plating Specifications—I (ds)_2-106 Spacecraft Lubrication in Outer Space by W. A.	Steelmaking Steel Slabs Cast by Pressure Pouring (fs) Strip Handling Device Unwinds Vertical Coils (fs)  5-9	Turbines, gas The Automotive Gas Turbine, by Amedee Roy, Claude Belleau and Frederick A. Hagan
Lubrication in Outer Space, by W. A. Glaeser (d)	Strain gages Strain Gages Measure Loads on Subway Tube (tn)	Turbine blades A Stainless Steel for High Temperature Service, by Edward L. Bedell, Thad T. Rick and Donald J. Beerntsen
Braxing Strengthens Weldments in Stator Rings (tr).  Cheaper Stainless Steel Substitutes for Type 302 and 304 (tr).  Closing the Metal Gap, by Walter L.	Strain hardening Strain Hardening in Copper and Aluminum, by F. P. Bullen and M. M. Hutchison (d)	Turbine wheels Huge Turbine Wheel Forged From Strong Alloy (tn)
Closing the Metal Gap, by Walter L. Finlay and Joseph R. Lane	Stress corrosion Case Histories of Materials Failure, by Paul Ogden 1-03 Stress Corrosion in Stainless Steels	Twinning Deformation Twins in Tungsten, by Jack L. Taylor (c)
(d) 6-182  Materials Selection in the Auto Industry 4-152  Military Plating Specifications—II (ds).3-106	(d) 2-154  Stress relief Modern Heat Treating Practices. 4-103	Vacuum furnaces Seen and Heard at ASM's Metalwork- ing Exhibition and Technical Sessions in Milwaukee (tn)
Modern Heat Treating Practices	Stresses, residual Mensuring Stress in Steel Parts by	Vacuum melting High Vacuum Degaasing With Induc- tion Stirring Makes Cleaner Steels, by Thomas E. Perry
Claude R. Bishop. 3-88 Stress Corrosion in Stainless Steels (d) 2-154 Steel	X-Ray Diffraction, by Donald A. Bol- stad, Robert A. Davis, William E. Quist and Earl C. Roberts	Vapor deposition coating Chemical Vapor Deposition, by John M. Blocher (d)
Anomalous Precipitates in Steel, by Charles Crussard, Guy Henry and Jean Plateau (d)	Stretch-Draw Press Automated for Fast Forming (tm)	Welding High Frequency Welding Joins Dis- similar Metals (tm). 2-9
gassed Steel (In) 6-7 Casting Slabs Continuously, by P. Des- fossez (d) 3-170 Characteristics of Induction Hardened Axles, by Richard K. Wuerfel 6-93	Swaging How Swaging Affects Mechanical Properties of Steel, by Romeo L. Suffredini	Introducing Two Weldable Aluminum Alloys: 74S and C74S, by Ian Taylor. 5-74 Meeting the Challenge of Change in Welding NASA Offers Tips on Welding Alu-
Chromium Case on Steel Strip Fights Corrosion and Heat (ts.) Closing the Metal Gap, by Walter L Finlay and Joseph R. Lane 3-79 Columbium Treated Steel Improves	Tantalum alloy Tungsten Raises Strength of New Tantalum Alloy (tn)	minum (tn).  Seen and Heard at ASM's Metalwork- ing Exhibition and Technical Sessions in Milwaukee (tn)
H. Walter. 6-82 Corrosion Control by Materials Selec- tion, by Carl H. Samans 3-74 Delayed Brittle Failure in Cadmium Plated Steels, by Walter Beck and	Tempering The Fifth Stage of Tempering, by August Kasak, Vijay K. Chandhok and Edward J. Dulis	2-8 Toughness of Welds in 18% Ni Steel, by Laurence N. Hjelm (c)
Edward J. Jankowsky. 2-92 Evolution of Chromium Plating of Automotive Hardware, by Charles Melekian, John Tierney and James H. Lindsay. 4-167	Thermistors Stable Thermistors Made From Silicon Carbide Crystals (In)	Welding, arc Consumable Insert Rings for Better Pipe Welds, by Helmut Thielsch 3-91 Welding in Controlled Atmospheres, by
reach Experience With Continuously Cast Steels for Automotive Parts, by Michel Misson and Jacques Pomey 4-123  How to Determine Case Depths by	Tin  Alloying Elements and Tin Oxidation, by W. E. Boggs, R. H. Kachik and G. E. Pellissier (d)	Welding in Controlled Atmospheres, by Kenneth J. Miller
Hardness Tests, by Melvin C. Vagle, Jr. 1-84 How to Determine the Staining Ten- dencies of Quenching Oils by G. R. Furman 2-85	Tin plate  An Additive for Tin Plating, by M.  Clarke and S. C. Britton (d)	(tn) 1-9 Unusual Joining Techniques, by Robert C. Bertossa (d) 5-152 Welding in Controlled Atmospheres.
Huge Turbine Wheel Forged From Strong Alloy (tn)	Meeting the Challenge of Change in Steels, by Carl R. Weymueller	Welding, friction Unusual Joining Techniques, by Robert
Meeting the Challenge of Change in Steels, by Carl R. Weymueller4-126 Problems in Making Die Castings of Steel, by V. M. Belov and S. A. Kazennov (d)3-161	Titanium Closing the Metal Gap, by Walter L. Finlay and Joseph R. Lane	C. Bertossa (d)
Progress in Extruding Steel With Glass Lubricants, by R. Hubert and H. Thannberker Scale-Free Heating of Steel, by A. C. Demoulin 2-77	Titanium alloys	X-ray diffraction
Special Ferromanganese for Free- Machining Steels (tn)	Big Coils of Titanium Tubing Produced for Chemical Plant (tm)	X-Ray Diffraction, by Donald A. Bol- stad, Robert A. Davis, William E. Quist and Earl C. Roberts
Cars (tm). 6-9 Testing Steel Plates Ultrasonically, by W. Dick, P. Hoeller and E. Lachky (d) 2-168	Modern Heat Treating Practices4-110  Transformation diagrams Cooling Transformation Diagram for	Zinc Chromate Coatings for Protecting Non- ferrous Metal Surfaces, by Walter E. Pocock Frobution of Chromium Plating of 1-100
Steel, maraging Toughness of Welds in 18% Ni Steel, by Laurence N. Hjelm (c)	AISI 3140	Evolution of Chromium Plating of Automotive Hardware, by Charles Melekian, John Tierney and James H. Lindsay
Working With Maraging Steels Nitriding, by John B. Seabrook. 1-78 Working With Maraging Steels Welding, by C. E. Witherell, D. A. Corrigan and W. A. Petersen 1-81	Steels 4-130  Tubing Big Coils of Titanium Tubing Produced	Zinc alloys  Zinc-Aluminum Alloys, by Ogle R.  Singleton, Jr. (sr)
iteel castings Huge Castings of 4340 Steel (tn) 2-10	for Chemical Plant (tn) 3-7 Guidelines for Specifying Seamless Tubing (tn) 5-9	Zirconium  Deterioration of Stabilized Zirconia, by John D. Buckley (d)2-158

### **Author Index**

Angus, H. C. (d)	3-15
Austin, David E.	0-:
Bain, Edgar C.	4-12
Ballard, W. E. (d)	2-16
Barker, James F.	6-8
Barth V D (d)	6-16
Datell, V. D. (8)	0-10
Beck, W. (a)	0-17
Beck, Walter	Z-9
Bedell, Edward L	1-9
Beerntsen, Donald J	1-9
Belleau, Claude	4-13
Relay V M (d)	9-16
Dennett Cur V (a)	9.11
Dennett, duy v. (c)	1 100
Bertossa, Robert U. (d)	.1-138
(d) 2-134; (d)	5-15
Billings, George W., Jr	3-9
Bishop, Claude R.	3-8
Blocher John M Jr (d)	5-18
Rooms W E (d)	6-17
Polstad Danold A	1 0
Bain, Edgar C. Bailard, W. E. (d) Barker, James F. Barth, V. D. (d) Beck, W. (d) Beck, W. (d) Beck, W. (d) Beck, W. (d) Beck, Walter Bedell, Edward L. Beerntsen, Donald J. Belleau, Claude Belov, V. M. (d) Bernett, Guy V. (c) Bertossa, Robert C. (d) Billings, George W. Jr. Bishop, Claude R. Blocher, John M., Jr. (d) Bolstad, Donald A Brandt, W. E. Britton, S. C. (d) Bullen, F. P. (d) Bullen, F. P. (d) Burevich, Ya. B. (d)	1-8
Brandt, W. E	5-90
Britton, S. C. (d)	3-194
Buckley, John D. (d)	2-158
Bullen, F. P. (d)	3-164
Burevich Ve B (d)	9.15
Darevien, I.a. D. (0)	
O M	
Callcut, V. A. (d)	1-152
(d)	3-178
Campbell, H. S. (d)	3-186
Carroll N L.	6-113
Carter V F (d)	3-186
Charles William V	- 0 A C C
Chandrok, Vijay K	0.407
Clarke, M. (d)	3-190
Clarkin, Philip A. (d)	5-158
Coons, William C	6-120
Corrigan, D. A	1-81
Crickmer Robert R	5-116
Cruspand C (d)	1.140
Callcut, V. A. (d) (d) Campbell, H. S. (d) (d) Carroll, N. I. Carter, V. E. (d) (Chandhok, Vijay K. Clarke, M. (d) (Clarkin, Philip A. (d) (Coons, William C. Corrigan, D. A. Crickmer, Robert R. Crussard, C. (d)	-1-140
Davis, Robert A.           Demoulin, A. C.           Denny, John P.           DePierre, Vincent           Dermott, Ralph G.           Desfossez, P. (d)           Dick, W. (d)           Duils, Edward J.	
Davis, Robert A.	1-88
Demoulin, A. C	2-77
Denny, John P	.1-111
DePierre: Vincent	5-90
Dermutt Rainh C	4-181
Desformer D (d)	9 170
Distorez, F. (a)	.0-110
Dick, W. (d)	2-163
Dulis, Edward J	5-82
Eborall, R. (d)	1-152:
(4)	3-178
Pissistein Harbort I	5 110
Emelstein, Herbert L.	C 100
Emerson, P. J. (a)	.0-103
Erichsen, Wallace J.	3-98
Eborall, R. (d)	6-128
Ferreira, Laurence E	-100 -
a cricara, Laurence Limit	£ 10°
E3:1 E3 SE5 (-)	E 100
Filer, E. W. (c)	.0-126
Finlay, Walter L	3-79
Fleischmann, Walter L.	5-122
Foulke, D. Gardner	6-107
Ferreira, Laurence E.  Filer, E. W. (c).  Finlay, Walter L.  Fleischmann, Walter L.  Foulke, D. Gardner.  Fowler, Robert M.	3-88
W. T	

Fuller, William E. (c) Furman, G. R Furth, John V. (c)	3-1
Gebauer, Georg Gibbon, G. L. (e). Glaeser, W. A. (d). Glanville, D. E. (d). Goehler, Donald D. Graue, Georg. Gray, Allen G. (cp). (cp) 5-78; Gutierrez, Conrado P. (c	2- 3-1 3-1 3-1 3-1 2- (cp) 6-8 d)6-1
Hagan, F. A.	4-13
Hageman, L. Coulson.  Harper, S. (d) 1-152;  Henry, Guy (d)  Herring, James (d)  Hidebrand, John F.  Hjelm, Lawrence N.  Hoeller, P. (d)  Hoffman, C. A. (d)  Hoffman, C. Gordon (c)  Hubert, R.  Hughes, E. T.  Huuter, Donald B. (c)  Hutchison, M. M. (d)	(d) 3-17 1-14 6-18 2-9 (c) 6-13 2-16 3-11 2-7 5-8 1-11: 3-16
Jackson, Carence E	2-9
Kachik, R. H. (d) Kasak, August Kazennov, S. A. (d) Ketcham, S. J. (d) Kieiner, Walter B. (d) Klima, S. K. (d) Kondic, V. (d) Krudtaa, Ole J. (c) Kunze, Robert J	6-17 5-8 3-16 5-17 3-17 2-16 3-18 1-110 2-9
Lachky, E. (d) Lane, Joseph R Lindsay, James H	3-79 4-16
Lueckerath, Werner	6-101
McGraw, L. D. (ds)	1-106 -6-86 4-16 3-118 -5-78 5-118 4-123 6-178
Nachtigall, A. J. (d) Nordmark, G. E	2-161 5-101
O'Brien, R. L. (d)	
Pellissier, G. E. (d)	

Parlmutter T	5.0
Perlmutter, I	9-8
Potorson W A	1-8
Petersen, W. A Phillips, Austin (e)	9,11
Plateau Jean (d)	1-14
Pocock Walter F	1-100
Pomer Incomes	4-19
Plateau, Jean (d)	5.8
Quist, William E.	
Quist, William E	1-88
Rasmussen, Jens Gert (d).	5-168
Rew, R. (d)	6-169
Rew, R. (d)	1-96
Roberts, Earl C.	1-88
Rogers, G. T. (d)	3-183
Roy, Amedee	4-137
Rushman, Warren F.	6-91
Rogers, G. T. (d) Roy, Amedee Rushman, Warren F. Ryder, D. A. (sr)	2-111
	3-73
	_ 3-74
Santschi, William H Schaller, Gilbert S. (sr) Schane, Harry P. (d)	1-111
Schaller, Gilbert S. (87)	3-115
Schane, Harry P. (d)	0-182
Schuster, Joseph W Scott-Maxwell, I. S. (d)	1-109
Scott-maxwell, 1. S. (a)	0-109
Shuttleworth Edwin (a)	E 196
Shuttleworth, Edwin (c)	9 100
Sikora Paul F (d)	5-159
Singleton Ogle P In (and	5-194
Smith I P (e)	5-126
Sparks, Robert R	1-74
Stacy, John T. (c)	5-126
Stubbington, C. A. (ar.)	2-111
Stuligross, Ralph J.	6-86
Scott-Maxwell, I. S. (d) Seabrook, John B. Shuttleworth, Edwin (c) Sikora, Paul F. (d) Sikora, Paul F. (d) Singleton, Ogle R., Jr. (sr) Smith, J. P. (e) Sparks, Robert B. Stacy, John T. (e) Stubbington, C. A. (sr) Stuligross, Ralph J. Suffredini, Romeo L.	2-109:
***************************************	3-85
Taylor, Ian	. 6.06
Taylor Jack I. (c)	6-126
Thanharger H	9.74
Thielsch Helmut (cu)	2.73
amenda, atelinae (cp)	8-91
Lierney, John	4-167
Townsend, D. W. (d)	1-152:
Tierney, John Townsend, D. W. (d) (d)	3-178
Vagle, Melvin C., Jr Vian, R. (sr)	2-111
Walker, B. (d) Wallace, Terry C. (d) Walter, Gordon H. Warga, Joseph J. Weeton, John W. (d) Weymueller, Carl R. 4-126; (d) Wickham, R. J. (d) Witherell, C. E. Wolkodoff, Vladimir E.	.3-180
Wallace, Terry C. (d)	.6-173
Walter, Gordon H	6-82
Warga, Joseph J	3-109
Weeton, John W. (d)	6-158
Weymueller, Carl R	3-113;
4-126; (d)	6-146
Wickham, R. J. (d)	.6-180
Witherell, C. E	1-81
Wolkodoff, Vladimir E	5-109;
	6-101
Wuerfel, Richard K	6-93

Young, John D. .....4-162

